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SLAUGHTERHOUSE AND PACKING HOUSE WASTES:
THEIR TREATMENT AND DISPOSAL. ANNOTATED
BIBLIOGRAPHY

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July 1951

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ANNOTATED BIBLIOGRAPHY
SLAUGHTERHOUSE AND PACKING HOUSE WASTES
THEIR TREATMENT AND DISPOSAL

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INTRODUCTORY REMARKS

This annotated bibliography was prepared in conjunction with a critical study of the literature relating to the treatment and disposal of slaughterhouse and packing house wastes. The bibliography was culled from such sources as Chemical Abstracts and Engineering Index, together with bibliographies listed by authors in published papers. In so far as possible the original papers were examined. In some cases, particularly with foreign reference material, only an abstract was readily available.

Where the paper was unavailable to the writer in either complete or abstract form, a blank space was left following the listing of the paper. Should the paper ever become available, the material will be added. As new material is published, references to these will be included.

All entries are listed in accordance with the year of publication, or, in some instances, under the date of the abstract. The references are listed in alphabetical order according to the author under each year of entry. Where more than one article is listed by the same author during a particular year, the subsequent entries are noted by the line ____ followed by the letters (b), (c), etc.

Where a discussor's name is listed his comments appear immediately after the paper discussed and are denoted by the symbol (2) following the primary entry (1).

Another deviation from most listings is that only the first author's name is listed in reverse order, i.e., last name first.

For the most part periodical abbreviations are those listed by Chemical Abstracts. The exceptions are few and include Sew. & Ind. Wastes for Sewage and Industrial Wastes, Water & Sew. Works for Water and Sewage Works, and Sew. Works Eng. for Sewage Works Engineering.

It would be appreciated if omitted references are called to the writer's attention that they may be included in subsequent releases of this bibliography. In addition, any comments relating to the arrangement and presentation of the material will be appreciated.

The material contained in this report is not for publication.

CPS
July 1951

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SLAUGHTERHOUSE AND PACKING HOUSE WASTES

THEIR TREATMENT AND DISPOSAL

ANNOTATED BIBLIOGRAPHY

1950

Agar, Charles C. Forum on Industrial Waste Problems. Cannery, Milk and Food Products. Sew. & Ind. Wastes, 22: 776-779 (June).

A very brief discussion of slaughterhouse wastes is given with the effect of the wastes on the receiving stream. Treatment methods are listed.

Bradney, Leland, Walter Nelson, and R. E. Bragstad. Treatment of Meat Packing Wastes. Sew. & Ind. Wastes, 22: 807-816 (June). Discussion by: Sawyer, Clair N., pp. 816-819.(2).

(1) Packing house wastes may be treated with municipal sewage if special precautions are observed in handling the high nitrogen wastes. At Sioux Falls, So. Dak., rapid and complete removal of the activated sludge from the final tanks was found to be of paramount importance. Data are given which show the effectiveness of special suction-type removal equipment.

(2) A comparison is made of Sioux Falls and Chicago experiences with packing house wastes and shows that much lower unit losses occur at Chicago for organic nitrogen, suspended solids, biochemical oxygen demand, and grease. Loading data are given for backwash-type high-rate trickling filters and these show lower removals than those indicated in the National Research Council or Upper Mississippi Reports. A need for the study of the hydraulics of sludge movements is stressed along with the provision of yardsticks for defining losses.

Ryan, William A. Industrial Waste Lagoons. Sew. & Ind. Wastes, 22: 71-55 (January). Discussion by: Searls, Glenn, pp. 75-76.(2).

(1) Lagoons may be used to further stabilize pretreated slaughterhouse wastes. Details are given for the operation of lagoons and results are reported for the lagoon-treated slaughterhouse wastes near Rochester, N. Y.

1950 (continued)

(2) Cost data for estimating the cost of construction for lagoons are given.

Washington State Pollution Control Commission. Minimum Requirements for the Control of Industrial Wastes. Sew. & Ind. Wastes, 22: 514-520 (April).

Minimum requirements are given for the control of wastes from slaughterhouse and meat packing plants.

1949

Benham, Webster L. Oklahoma City Builds Two-Stage Trickling-Filter Sewage Disposal Plant. Civ. Engr., 19: 17-21 (May).

A description is given along with design data for the sewage treatment plant which will treat slaughterhouse, packing house and oil field wastes as well as domestic sewage.

. (b). Two Types of Trickling Filters Chosen for Oklahoma City. Sew. Wastes Eng., 20: 333-336 (July).

Same as above.

Dunmire, E. H. Huron, So. Dakota Treats Sewage and Packing House Waste. Water & Sew. Works, 96: 431-434 (November).

Data are given on the treatment of packing house wastes and sewage.

Eldridge, E. F. Packing Plant Wastes Treated by Recirculating Filter. Sew. Works Eng., 20: 27 and 37 (January).

Operation of treatment plant for wastes from a small packing house is described. Data are reported.

Huppert, J. Chemical Treatment of Packing House Wastes. Public Works, 80: 3, 35-36 (March).

Chemical treatment utilizing sulfuric acid, alum and chlorine dioxide is reported to have been used successfully in the treatment

1949 (continued)

of packing house wastes by a North Texas packer. Data on chemical costs are included.

Klassen, C. W. and W. A. Hasfurther. Treatment of Wastes from Small Packing Houses. Sew. Works Eng., 20: 136-138 and 166-167 (March).

The use of ferric chloride for the treatment of Illinois packing house plant wastes is reported. Operating data are also given.

Mohlman, F. W. Disposal of Packing House Wastes. Research Conference, American Meat Institute, University of Chicago.

A review of packing house disposal techniques is presented along with a discussion of the results obtained at Chicago, unit losses, seasonal losses, packing house waste treatment, and the results reported at other installations.

Nelson, D. H. Meat Packing Wastes and Their Pretreatment. Sew. Works Eng., 20: 352-384 (August).

A detailed discussion is presented of packing house wastes with a description of the sources of the wastes and suggestions for the salvage of grease and nitrogen.

Uhlmann, Paul A. Activated Sludge Treatment of Rendering Wastes. Sew. Works Eng., 20: 330-332 (July).

A rendering plant is described that was built to produce white tallow for soap manufacture and meat scraps for livestock feed. Data are reported on the operation of the activated sludge plant.

Wynmore, A. H. Trickling Filter Plant for a Small Meat Packing Plant. Sew. Works Eng., 20: 347 and 355 (July).

A description is given of the plant and the design factors are noted.

1948

Anon. Treating Slaughterhouse Wastes in Iowa. Sew. Works Eng., 19:

1948 (continued)

206 (April).

Material on Iowa practice extracted from the West Virginia Water Commission Report "Slaughterhouse Waste Treatment Guide" is presented. See "West Virginia Commission" under "1946".

Beard, Arthur H., Jr. Design of a Grease-Recovery Plant for a Meat Packer. Proc., 4th Ind. Waste Conf., Purdue U., pp. 129-140 (September 21-22).

Estimates are given of the amount of grease resulting from the various operations taking place in a packing plant. The design of grease separation units is discussed. Details of operation are given also. Some cost data are included.

Benoit, R. Plant for Utilization of Waste Products from Abattoirs. Schweiz. Arch. Tierheilk., 88: 372 ().

A small plant is described which produces feed from autoclaved slaughterhouse wastes.

Brevot, G. Disposal of Slaughterhouse Wastes. Tech. sanit. et munic. (France), pp. 79-87 (November - December, 1946). Abstracted in Sew. Works J., 20: 595-596 (May).

Bacteriological data are reported for abattoir wastes at Villette and compared with counts obtained for Paris sewage. Suspended solids and biochemical oxygen demand values are indicated.

Jones, E. E. Waste Waters Discharged from an Abattoir. Surveyor, 107: 159-160 (March 26).

Analytical results are reported following a study of a small slaughterhouse in England.

Mohlman, F. W. Discussion of Jones paper "Waste Waters Discharged from an Abattoir". Surveyor, 107: 294 ().

A preference is noted for reporting losses in terms of live weight rather than in terms of hog unit. An attempt was made to convert the Jones' data, and the statement is made that British losses are considerably lower than losses indicated in American practice.

1948 (continued)

Mohlman, F. W. (b). Possibilities of Recovery and Utilization of Industrial Wastes. Trans., Am. Soc. Civil Engrs., 114: 338-347.

Unit losses are given, salvage operations are discussed, and the total effect of the biochemical oxygen demand of the wastes in the United States is indicated.

Sanders, M. D. Chemical Precipitation of Meat Packing Wastes. Ind. Eng. Chem., 40: 1151-1152 (June).

A method is described in which proteins and emulsified fats are precipitated at a pH of 4.0-5.2 and coagulated with alum or ferric salts. The recovered sludge is to be used as an ingredient in animal feed.

(b). Treatment of Packing House Sludge. U.S. 2,277,718
(March 31).

A patent issued on a process for treating and dewatering sludge for use as an animal feed.

Southgate, B. A. Treatment and Disposal of Industrial Waste Waters. His Majesty's Stationery Office, London, England.

See Chapter 16. Slaughterhouse and Manufacture of Fish Meal. A review of slaughterhouse waste treatment and disposal practice is presented.

Stienke, Robert E. Disposal of Wastes from Small Abattoirs. Proc., 4th Ind. Waste Conf., Purdue U., pp. 178-202 (September 21-22).

The results obtained in the study of a small abattoir are reported. Chemical precipitation using alum and high-test hypochlorite was found to be most satisfactory. Cost data are given.

Watson, Kenneth S. Industrial-Waste Treatment and Recovery in West Virginia. Proc., 4th Ind. Waste Conf., Purdue U., pp. 20-31 (September 21-22).

Reference is made to the material contained in the West Virginia Water Commission's Report "Slaughterhouse Waste Treatment Guide". See under "1946".

1947

Anon. Slaughterhouse Waste Treatment by Filters and Activated Sludge. Sew. Works Eng., 18: 255-257 (May).

A review of the material contained in the West Virginia Water Commission's "Slaughterhouse Waste Treatment Guide". See under "1946".

Dufan, A. Purification of Wastes from Small and Medium Size Abattoirs. Eau, 34: 37 (). CA, 41: 3879.

A French article describing a system of complete treatment involving settling, chemical coagulation, trickling filters, and digestion.

Fischer, A. J. Dual Clarifier and Filter Structures Simplify High-Rate Treatment Process. Eng. News-Record, 139: 64-66 (July 10).

A description of the Trebler Duo-Clarifier is given and it is reported that such an installation is in use at a packing house in Kansas City, Missouri.

Mohlman, F. W. The Industrial Waste Problem. I. Packing House, Brewery, and By-Products Coke Wastes. Sew. Works J., 19: 473-477 (May).

The use of chemical treatment is described. There is some discussion of treating wastes from packing houses with domestic sewage. Limits are noted for plant losses.

(May). (b). Packing House Industry. Ind. Eng. Chem., 39: 637-641

Data are presented on the losses from 14 plants. Overall national loads are estimated. Treatment methods are described.

(c). Salvage and Wastes in the Packing House Industry. Sew. Works Eng., 18: 259 (May).

Data are presented on unit losses. The methods that may be or are in use for the treatment of the wastes are indicated and methods are suggested for reducing the losses in the plant.

1947 (continued)

Plarchon, R. The Supply and Purification of Water for Abattoirs. Eau (French), 34: 31 ().

Slaughterhouse waste characteristics and treatment methods in use in France are discussed.

Rudolfs, Willem and Victor Del Guercio. Sand Filtration of Some Organic Wastes. Water & Sewage Works, 24: 349 (September).

Settled slaughterhouse wastes were applied to sand filters. Data are presented showing biochemical oxygen demand removals and nitrogen transformations.

Shephard, C. C. An Outbreak of Q Fever in a Chicago Packing House. Am. J. Hyg., 46: 185-192 (September).

Steffen, A. J. What to Do About Paunch Wastes? Proc., 3rd Ind. Waste Conf., Purdue U., pp. 268-271 (May 21-22).

Listed are the various methods used to recover the solids from paunch manure. Some data are presented on the chemical analyses of undiluted paunch contents.

Topping, H. E., C. C. Shephard, and J. V. Irons. Q Fever in the United States. I. Epidemiological Studies of an Outbreak Among Stock Handlers and Slaughterhouse Workers. J. Am. Med. Assoc., 133: 813-815 (March 22).

Fifty-five cases including two deaths of Q-fever are reported among 136 workers engaged in the handling and slaughtering of cattle at Amarillo, Texas.

Turner, C. W. The Male Hormone Content of Ruminant Manure. J. Dairy Sci., 30: 1-8 ().

The effectiveness of dried rumen contents in promoting growth in chickens is reported.

1946

Eldridge, E. F. Meat Packing Waste Disposal. Mich. State Coll. Agr., Eng. Exp. Sta., Bull. 105: (December).

Characteristics of wastes from slaughterhouses and packing houses, salvage, grease collection and recovery, and methods of treatment are covered.

Levine, Max. Some Observations on the Treatment of Packing House Wastes. Southwest Water Works J., 28: 2, 27-33 ().

The principles underlying the "serial filtration system" are presented and comparisons are made of the efficiency obtained in the treatment of packing house wastes by means of this type of installation and the standard filter treating domestic sewage.

Mortenson, E. N. Grease Recovery in the Meat Packing Industry. Proc., 2nd Ind. Waste Conf., Purdue U., pp. 28-39 (January 10-11).

A novel procedure is indicated for determining the efficiency of grease removal. Factors affecting grease losses are discussed and recommendations are made for reducing these losses.

West Virginia Water Commission. Slaughterhouse Waste Treatment Guide, 20 pages (November 15).

Work on slaughterhouse wastes in other states is reviewed. The scope of the problem in West Virginia is indicated. Two types of treatment are suggested depending on the daily kill.

1945

Anon. How Midwest Plant Meets Waste Treatment Problem. The Nat. Provisioner, 112: 14 (February 24).

1945 (continued)

Anon. Packing House Grease Recovery and Sewage Disposal. Meat Packers Guide, pp. 54-59.

Clemens, Robert F. (Patent assigned to Dorr Company). Removal of Suspended Matter from Polluting Wastes such as Sewage, Dairy, Packing, Canning, and Oil Refinery Wastes. U. S. 2,375,282 (May 8)

A patent was issued on a process involving flotation or settling under reduced pressure.

Hill, Kenneth V. Treatment of Packing House Wastes. Sewage Works J., 17: 292-306 (March).

A discussion is presented of the treatment of packing house wastes and includes the magnitude of the problem, difficulties inherent in treatment, quantities of waste, seasonal variation in kill and quantities of wastes, instantaneous rates of waste production, packing house practice, methods of pretreatment, and a description of the treatment procedures at Austin and Sioux Falls.

Mohlman, F. W. Plain Talk About Industrial Waste Recovery. Sewage Works Eng. and Munic. Sanit., 16: 489-490 ().

Variations in grease, biochemical oxygen demand, and nitrogen losses in packing house wastes are indicated.

1944

Bragstad, R. E. Industrial Wastes at Sioux Falls, South Dakota Proc., 1st Ind. Waste Utiliz. Conf., Purdue U., pp. 22-30 (November 29-30).

A review is presented of the legal and financial agreements between the packer and the City of Sioux Falls.

1944 (continued)

Bragstad, R. E. (Presiding). Symposium on Meat Packing Wastes. Proc., 1st Ind. Waste Utiliz. Conf., Purdue U., pp. 178-183 (November 29-30).

A question and answer discussion of problems pertaining to meat packing wastes.

Dawson, F. M. and A. A. Kalinske. Design and Operation of Grease Interceptors. Sewage Works J., 16: 482-489 (May).

The hydraulic principles governing satisfactory grease interceptor design are presented. A description of the plant set-up for testing and rating commercial grease traps is given.

Hammond, J. C. Dried Cow Manure and Dried Rumen Contents as a Partial Substitute for Alfalfa Leaf Meal. Poultry Sci., 23: 471-474 ().

It is reported that dried cow manure, dried rumen contents and fish meal contain a nutrient which promotes rapid growth, hatchability, and high efficiency of feed utilization and reduces mortality in chickens.

Mohlman, F. W. Utilization and Disposal of Industrial Wastes. Proc., 1st Ind. Waste Utiliz. Conf., Purdue U., pp. 43-47 (November 29-30).

Comparisons are made of the biochemical oxygen demand to nitrogen ratios of various wastes including packing house wastes.

Sanders, M. D. Treating Packing House Waste Water or Sludge Containing Proteins. U.S. 2,328,361 ().

The proteins are precipitated, separated from the effluent, coagulated by heating, and a calcium salt is added. The final solids are recovered from the sludge.

U. S. Public Health Service. Ohio River Pollution Control. Supplements to Part II. Report of the United States Public Health Service, U. S. Government Printing Office, Washington, D. C.

1944 (continued)

An Industrial Waste Guide to the Meat Industry, pp. 1139-1154. A review of packing house and slaughterhouse waste treatment practice is given along with findings from many plants surveyed in the Ohio River Basin area.

1943

Eldridge, E. F. Recirculating Filters for Treatment of Slaughterhouse Wastes. Water Works and Sewerage, 90: 449-451 (December).

See Eldridge, E. F. under 1949.

Gottlieb, W. Fort Dodge Makes a Profit on Power; Gas Engine Incor-
40% of Plant Costs. Sewage Works Eng. and Munic. Sanit., 14: 179-181
().

A description is given of the plant for the combined treatment of municipal and packing house wastes.

Mahlie, W. S. Industrial Waste Pre-Treatment at Fort Worth, Texas. Sewage Works J., 15: 521-524 (May).

The various sources of wastes from packing houses, consisting of waste blood, wash waters from the killing floors, wastes from the wet rendering process, and paunch wastes are noted. Analytical data are presented.

Mohlman, F. W. Industrial Waste Disposal. Chem. & Met. Eng., 50:
78-81 (January) and 127-131 (February).

A discussion of the possibility of salvaging materials from sewage and a wide variety of industrial wastes is presented. Estimates are given of the cost of treating the wastes produced in the United States, of the volume of wastes produced in the Ohio River Basin, and of wastes contributed by industries in the Sanitary District of Chicago.

(b). Industrial Wastes in Wartime. Sewage Works J., 15:
1164-1177 (November). Discussion by: Van Kleeck, LeRoy W. Pp. 1177-
1181.

1943 (continued)

Increased wartime production has increased the population equivalent of wastes in the Chicago Sanitary District by about one-half million.

Mortenson, E. N. Are You Losing War Materials and Dollars Down Your Sewer? The Natl. Provisioner, : (April 24-May 1).

Study of the losses of grease in packing plants was made and a procedure is described for determining the loss of grease.

Robinson, W. Merle. Fallen Animals - A Little Known Process Industry. Chem. & Met. Eng., 50: 112-115 (August).

Methods are given for rendering fallen animals for the recovery of hides, hair, wool, greases, tankage, etc., for use in manufacturing and agriculture.

1942

Anon. Heavy Industrial Load Outranks Domestic Sewage. Am. City, 57: 52-53 (February).

The slaughterhouse waste load at the Watertown, South Dakota, sewage treatment plant accounts for 80 per cent of the biochemical oxygen demand load of the combined wastes.

Eldridge, E. F. Industrial Waste Treatment Practice. McGraw-Hill Book Company, Inc., New York and London. Chapter X. Meat Packing and Slaughterhouse Wastes, pp. 265-282.

A textbook. Meat packing and slaughterhouse waste sources are indicated and methods of treatment are noted.

_____. (b). The Recirculating Filter for the Treatment of Slaughterhouse Wastes. Mich. State Coll. Agr.; Eng. Exp. Sta., Bull. 96: 18-21.

See Eldridge, E. F. under 1949.

1942 (continued)

Gilman, H. K. and B. K. Hartman. Packing Plant Waste Water Yields Valuable Grease. Link Belt News, 9: 7 (August-September).

A grease recovery plant is described for the pork packing plant of the Tobin Packing Company.

_____. (b). Tobin's Grease Recovery System Aids War Effort. Nat. Provisioner, 106: 14 (June 6)

Same as Gilman, H. K. and B. K. Hartman above.

Hammond, J. C. Cow Manure as a Source of Certain Vitamins for Growing Chickens. Poultry Sci., 21: 554-559 ().

Dried rumen contents may be used as a food source and have been found beneficial in promoting growth in chickens.

Hurst, D. H. Guarding a City's Health with Sewage Treatment. Am. City, 57: 12, 38-39 (December).

A plant is described for pretreating packing house wastes before combination with municipal sewage. Some operating data are reported.

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McGarkey, P. H., H. F. Eich, Herbert Wm. Jackson, and Crosswell Henderson. Study of the Stream-Pollution Problem in the Roanoke, Virginia, Metropolitan District. Bull. 51. Virginia Polytech. Inst., Eng. Exp. Sta., 121 pp.

The effect of the discharge of industrial wastes including packing house wastes on stream conditions is noted.

Pittman, Earnest E. and Robert R. Bottoms. (Assigned to Girdler Corp.). Treatment of Packing House Waste. U. S. 2,261,924 (November 4).

A procedure is reported for separating proteinaceous material from packing house waste with bentonite as a precipitating agent.

1942 (continued)

Young, H. H. By-Products of the Meat Packing Industry. Chem. Eng. News, 20: 1660 and 1664 (December 25).

The by-products of the industry are listed according to source: beef, veal, lamb, and pork. Their uses are also noted.

1941

Anon. Meat Packing and Slaughterhouse Wastes in Texas. Public Works, 72: 19-20 (April).

This is an abstract of the material contained in a 70-page report entitled "Meat Packing and Slaughterhouse Wastes" issued by the Texas State Department of Health.

Bergold, Friedrich. Fat Recovery. Gesundh. Ing., 64: 500-501 ().

The processes in use for the recovery of fat in the meat-packing industry are noted.

Childress, G. L. Treatment of Meat Packing Plant Wastes. Sewage Works Eng. and Munic. Sanit., 12: 313-314 and 332 ().

Nature of packing plant wastes is given and methods are described for the treatment of wastes. The author notes that there is no satisfactory solution to the sludge problem.

Eldridge, E. F. The Recirculating High-Rate Filter in Industrial Waste Treatment. Water Works and Sewerage, 88: 483-490 (November).

A description of the Telfer Packing Company plant at Owasso, Michigan, is given.

Haseltine, T. R. Operating Fundamentals of the Activated Sludge Process. Water Works and Sewerage, 88: 274-279 ().

Sludge rising in the final tanks is encountered when highly nitrified wastes such as packing house wastes are treated.

1941 (continued)

Hurst, D. H. Modern Plant Solves Difficult Packing Plant Waste Problem. Public Works, 72: 8, 11 (August).

A description is given of the plant treating sanitary sewage and packing house wastes at Tifton, Georgia. Some analytical data are included.

Kornmesser, Gustav C. and Friedrich Gross. Collection of Sludge Pat. Gesundh. Ing., 64: 203-205 ().

High capacity collectors that increase the removal of fat by rapid cooling of the waste should be used in packing plants.

Savateev, A., N. Plospirev, K. Ivanov, and A. Bitkova. Growth of Microbes in Media Prepared from Waste of the Meat Industry. Zhur. Mikrobiol., Epidemiol. Immunobiol., No. 2, 105-110 ().

Hydrolyzed fish and bone meal was found to be a satisfactory food for bacteria.

Texas State Department of Health. Report on Meat Packing and Slaughterhouse Wastes.

1940

Codling, J. H. Treatment of Abattoir Wastes. Nature, 146: 9-12 (July 6).

Abattoir wastes are described and the ultimate uses of some of the waste materials are noted. Data are presented on the yields of some of the recoverable materials.

1940 (continued)

Howson, L. R. Packing House Waste Treatment. Water Works and Sewerage, 87: 217-222 (May).

The Armour plant at West Fargo is described. Design criteria are noted and some of the expected efficiencies are indicated.

Mohlman, F. W. The Growing Importance of Industrial Waste Disposal. Water Works and Sewerage, 87: 93-101 (March).

Descriptions are given of a large number of packing plants and removal efficiencies by a variety of processes are noted.

Sanders, Marion D. (Assigned to Industrial Patents Corp.). Treating Packing House Waste Water. U.S. 2,204,703 (June 18).

A process for the precipitation of protein by an inorganic acid and for flocculating the precipitated protein by an inorganic metal salt is described.

Siebert, Christian L. A Digest of Industrial Waste Treatment. Bureau of Engineering, Pennsylvania Department of Health (April).

A review of abattoir and packing house waste treatment practice is presented.

Sinakova, T. L. The Microflora Causing Decomposition of Organic Matter in Methane Tanks. Microbiology (U.S.S.R.), 9: 845-852 (in English, p. 853).

A specific microflora splits the proteins contained in sewage deposits of a meat-packing plant to CH_4 and CO_2 . A non-specific microflora breaks the proteins down to amino acids.

Stecher, Eustach and Georg Rupprecht. The Effect of Abattoir Effluents on Munich's Sewage. Gesundh. Ing., 63: 151-155 ().

The abattoir effluent amounts to 2 per cent of the city sewage and furnishes 10 per cent of the total solids. Studies were made of 117 samples of effluent and analyses are reported.

1940 (continued)

Steinmann, Wilhelm. Apparatus for Treating Animal Matter Such as Carcasses or Fish Wastes. French Patent 851,735 (January 13).

Apparatus for extracting fat and disintegrating the remainder of the materials is described.

Young, H. H. Utilization of By-Products from the Meat Packing Industry. News Ed. (Am. Chem. Soc.), 18: 579-581 (July 10).

Developments, improvements, and properties of meat-packing by-products are discussed.

1939

Anon. Packing House Sewage Treatment. Nat. Provisioner, 100: 7 (March 25).

Childress, G. L. Some Meat Packing Plant Installations for the Treatment of Wastes. Southwest Water Works J., 21: 4, 23-24 ().

See Childress, G. L. under 1941.

_____. (b). Some Meat Packing Plant Installations for the Treatment of Wastes. Proc., 21st Texas Water Works and Sewage Short School, pp. 129-133 ().

See Childress, G. L. under 1941.

Hansen, Paul and K. V. Hill. Packinghouse Wastes and Sewage Treatment at Austin, Minnesota. Sewage Works J., 11: 1045-1053 (November).

Packing house pretreatment units and municipal sewage treatment plant facilities for treating combined waste are described. City has population of 18,000 and waste has population equivalent of 195,000.

1939 (continued)

Just, Jan. Treating Slaughterhouse Wastes. Gaz, Woda i Technika Sanitarna (Poland), 19: 307-316 (September).

The treatment of slaughterhouse wastes under conditions as they exist in Poland is discussed. The treatment methods that may be used are indicated. Primary consideration is given to methods of recovery.

Knechtges, O. J., Francis M. Dawson and M. Starr Nichols. Continuous Digestion of Mixtures of Sludges from Domestic Sewage and Packinghouse Wastes. Sewage Works J., 11: 819-827 (September).

Laboratory studies of the digestibility of sewage and packing house mixtures are described. It is reported that continuous digestion experiments are more reliable than batch experiments.

Lenz, K. Recovery of Fat from Rinsing Waters in Packing Plants. Vorratsphlege u. Lebensmittelforsch., 2: 343-352 ().

The various systems for the separation of fats are described and compared.

Mahlis, W. S. Trickling Filter Loadings at Fort Worth, Texas. Sewage Works J., 11: 472-479 (May).

A study was made of trickling filter loadings under various conditions when a mixture of domestic sewage and packing house waste was treated. Extensive analytical data are included.

Mohlman, F. W. The Disposal of Industrial Wastes. Sewage Works J., 11: 646-656 (July).

The amount of pollution contributed by various industries in the Sanitary District of Chicago are noted. The amount of packing house wastes discharged and the population equivalent of these wastes is also reported.

Ralston, Anderson W. and William M. Selby. (Assigned to Armour & Company). Nitrite-Containing Mixtures Somewhat Similar to Bone Oil. U.S. 2,164,284 (June 27).

1939 (continued)

A process is described by which nitrile-containing mixtures of nitrogenous organic compounds may be prepared from waste protein-containing materials such as waste material from the meat packing industry.

1938

Carollo, John A. Packing Waste Plant Pays Its Own Way. Munic. Sanit., 9: 175-176 (March).

A description is presented of the Tovrea Packing Co. plant in Phoenix, Arizona. Recovery is widely practiced since the sludge is sold, grease is reclaimed, the gas produced is sold, and the liquid effluent is used for irrigation. Some analytical data are given and the cost of operation is indicated.

Darby, G. M. and C. L. Knowles. Attacking Trade-Waste Problems. Chem. & Met. Eng., 45: 528-532 (October).

The use of by-products from waste to repay cost of treatment is emphasized. The importance of obtaining competent aid in designing a waste disposal system is stressed.

Eldridge, E. F. Industrial Waste Treatment Processes and Plant Design. Mich. State Coll. Agr., Eng. Exp. Sta., Bull. 82: (September).

Kelly, Earl M. A Problem of Major Importance to Sewage Works Operators: Handling Supernatant Liquor from Digestors. Eng. and Contract Record, 51: 4, 16-18 ().

When industrial wastes such as those from packing houses are present, the digester liquor will contain more solids than when such wastes are not included in the sludges.

1938 (continued)

Hodgson, Henry J. H. Sewage and Trade Wastes Treatment in America, Great Britain, Holland and Germany. Frank Trigg, Adelaide.

A book. Packing house and slaughterhouse wastes are discussed on pp. 408-425.

Milling, Martin A., and B. A. Poole. Disposal of Packinghouse Waste - The Kuhner Packing Company, Muncie, Indiana. Sewage Works J., 10: 738-746 (July).

A description is given of the activated sludge plant for treating the packing house wastes and operating results are summarized.

1937

Bragstad, R. E., and Leland Bradney. Packinghouse Waste and Sewage Treatment at Sioux Falls, South Dakota. Sewage Works J., 9: 959-969 (November).

The plant which treats combined domestic sewage and packing house waste is described and some of the operational difficulties are reported.

Green, H. R. Cedar Rapids Agreement with the Packers. Sewage Works J., 9: 950-958 (November).

The agreement between the packer and the city is described along with the financial arrangements made, and the treatment facilities to be provided by each group.

Green, H. R. The Cedar Rapids (Iowa) Combination Waste Treatment Plant. Water Works and Sewerage, 84: 239-246 (July).

A description is given of the plant provided for the treatment of domestic sewage and pretreated packing house wastes. Analytical data are presented.

Green, H. R., and J. C. McIntyre. Flocculation Studies Made in Connection with Treatment of Packinghouse Wastes at the Combination Plant at Cedar Rapids, Iowa. Water Works and Sewerage, 84: 383-388 (October).

1937 (continued)

The various procedures studied for the treatment of combined domestic sewage and packing house wastes are described. Results of tests are given.

Levine, Max, F. G. Nelson, and Elmer Dye. Experiments on Purification of Packinghouse Wastes at Mason City, Iowa. Iowa State Coll. Agr. Mech. Arts, Eng. Exp. Sta., Bull. 130:

The results of the experimental study of the Jacob E. Decker & Sons plant at Mason City, Iowa are presented. Very extensive data are included on the various procedures investigated.

Martin, F. Public and Industrial Slaughterhouses. Ann. Hyg. Publ. (Paris), 15: 217 (1937). Water Pollution Research, Summary of Current Literature, 11: 4, 141 (April, 1938).

Owning, L. F. Industrial Wastes and Their Effects on Municipal Sewage Treatment Plants. Mich. State Coll. Agr., Eng. Exp. Sta., Bull. 74: 20-27 ().

A brief summary of the effect of packing house wastes on sewage treatment plant operation is presented.

Shupe, Stanley. Effect of Industrial Wastes on Sewers and Treatment Works. Eng. and Contract Record, 50: 97, 15-17 ().

The experiences at Kitchener, Ontario are described.

1936

deChemin, C. and J. Guy. The Treatment and Purification of Waste Waters in Abattoirs. *Travaux*, (October); *Genie Civ.*, 110: 121 (1937).

Estabrook, Joseph B. Sewage Treatment at Sioux Falls. I. Historical, II. Experimental Plant, and III. Additions to Existing Plant. *Am. City*, 51: (I.) 83-84 (June), (II.) 47-49 (July, and (III.) 65-66 (August).

Equal volumes of domestic and packing house wastes are handled in a plant which includes trickling filters and activated sludge in series. A description is given of the 5 gpm experimental plant to study the problem. Cost data on the installation are given.

Luethkens, Ulrich. Physiologically Active Compositions. German Patent 624,894 (January 30).

Slaughterhouse materials such as liver and gall bladders are dried, extracted with alcohol, and the extract is dried to give active compounds. Examples are given.

Merryfield, Fred. Industrial Wastes in the Willamette Valley. *Civil Eng.*, 6: 682-684 ().

A table is presented which indicates the strength of various industrial wastes including packing house wastes found in the Willamette Valley. It is stated that the treatment required is a matter of individual study.

Titus, Harry W., T. C. Beverly, H. R. Ellis, and R. B. Nestler. Effect of Packing-House By-Products in the Diet of Chickens On the Production and Hatchability of Eggs. *J. Agr. Research*, 53: 453-465 ().

1936 (continued)

The products used in the tests included various kinds of meat meal, meat-and-bone meal, beef scrap, blood meal, and stick. The experiments confirm previous evidence regarding the value of protein supplements of animal origin, and direct attention to opportunities for improving such supplements by the development and use of suitable formulas and controlled methods of manufacture.

1935

Eldridge, E. F. Meat Packing Waste Treatment. Water Works and Sewerage, 82: 216-218 (June).

Various coagulation procedures were studied to determine their efficiencies and costs in treating packing house wastes.

Knechtges, O. J., Francis M. Dawson and M. Starr Nichols. Digestion of Mixtures of Sludge from Domestic Sewage and Packinghouse Wastes. Sewage Works J., 7: 3-16 (January).

Packinghouse-sewage sludge mixtures digested satisfactorily. Lipids digest to gas more completely than the bulk of the solids.

Levine, Max. Experiments on the Purification of Creamery and Packinghouse Wastes. Am. J. Pub. Health, 25: 171-181 (). Discussion by Hyde, Charles Gilman.

Results of experiments to show that the poor treatment obtained in the treatment of packing house wastes at Mason City, Iowa was not due to high salt concentration are presented. The plant was of the activated sludge type..

Planchon, Rene, and Dufournet. Collection and Treatment of Waste Waters from Modern Abattoirs. Tech. Sanit. Munic., 30: 75-89 ().

Methods of treatment vary but include screening and settling followed by biological treatment in septic tanks. Degree of treatment provided is dependent upon discharge source available, such as streams, ponds, canals or sewers. The effluent is chlorinated before discharge.

1935 (continued)

Van der Leeden, R. Recovery of Wastes from the Tanning and Meat Packing Industries. *Gesundh. Ing.*, 58: 194-195 ().

1934

Balboni, G. Chemical Analyses of the Flesh and Viscera of Slaughterhouse Animals. *Quad. Nutrizione*, 1: 275-283 ().

Tables are presented which give data on the edible portion, solid residue, nitrogen, protein, fat and ash of the ox, calf, horse, pig, and lamb.

Calvert, C. K. and Elliot H. Parks. The Population Equivalent of Certain Industrial Wastes. *Sewage Works J.*, 6: 1159-1164 (November).

Population equivalent data are provided based on a study of wastes produced by four small meat packers in Indianapolis.

Eldridge, E. F. The Treatment of Meat Packing Plant Wastes. *Mich. State Coll. Agr., Eng. Exp. Sta., Bull.* 60: 31 (November).

Results are reported of large-scale experiments on coagulation of packing plant wastes. The experiments indicate that chlorine was the most effective coagulant.

Holderby, J. M. and Wm. L. Lea. The Relation of the pH of Dilution Water to the Biochemical Oxygen Demand of Various Wastes. *Sewage Works J.*, 6: 734-741 ().

Laboratory studies indicated that domestic sewage, packing house wastes and milk wastes may be expected to give higher BOD values with bicarbonate dilution water.

1934 (continued)

Walton, G. P. and R. F. Garrison. Conservation of Wastes from the Small-Scale Slaughter of Animals. U. S. Dep. Agr., Circ. 63: 23 pp.

A revision of USDA Circ. 63 issued in June, 1929, in which additional data are given on yields of greases and tankages.

West Riding of Yorkshire Rivers Board. 41st Annual Report, Wakefield.

1933

Boruff, C. S. Stabilization of Paunch Manures and Packing-House Screenings. Ind. Eng. Chem., 25: 703-706 (June).

A description of the rotating drum-type sewage digester is given, in which cattle and hog paunch manure and packing house screenings may be digested into a stable residue.

Buswell, A. M., and C. S. Boruff. Mechanical Equipment for Continuous Fermentation of Fibrous Materials. Ind. Eng. Chem., 25: 147-149 (February).

A rotating drum-type digester was designed for the treatment of various types of waste materials.

Nitsche, Paul. The Precipitation of Colloids. Gesundh. Ing., 56: 21-22 ().

Slaughterhouse wastes were treated by the addition of oxidizing and coagulating agents.

1932

Chute, H. O. Evaporation as a Process of Reclamation and Prevention of Stream Pollution. Water Works and Sewerage, 79: 427-429 (December).

Rendering and evaporation of the liquid "consomme" to "stick" and the use of this material for chicken and hog feed eliminated the discharge of these materials to the stream.

Halvorsen, H. O., A. R. Cade, and W. J. Fullen. The Precipitation of Proteins in Packinghouse Wastes by Superchlorination. J. Phys. Chem., 36: 185-197 (January).

A description of the superchlorination process developed for the treatment of slaughterhouse and packing house wastes is presented.

Sommermeier, August. (Assigned to The Company Rud. A. Hartmann). Treating Slaughterhouse Waste, etc. U. S. 1,845,893 (February 16).

The apparatus and the procedure for converting a mixture of waste products to paste under pressure and of separating these products is described.

1931

Anon. Turning a Packing Plant Nuisance Into a Profit. Nat. Provisioner, 84: 19 (February 14).

Belani. Offal Utilization in Slaughtering Yards. Kunstdunger u. Leim, 28: 161-167 ().

The practical utilization of offal is discussed with special attention to the preparation of dried blood for fertilizer and blood albumin for adhesive and other purposes.

1931 (continued)

Bettels, J. The Purification of Industrial Waste Waters by Potash Lyes and Milk of Lime. *Kleine Mitt. Mitgleider Ver. Wasser-, Boden-, Lufthyg.*, 7: 44 ().

Experiments were carried out on the clarification of waste waters from slaughterhouses with $MgCl_2$ lye. An experimental plant was erected and is described. The sludge produced is a valuable fertilizer. Analyses and the results obtained are reported.

Fischer, Anthony J. Amelioration of Packing House Waste. *Chem. & Met. Eng.*, 38: 549 (September).

A review is presented of the Halvorson and Pullen process of superchlorination for the recovery of proteins from packing house wastes.

Fuller, W. P., and E. H. Anderson. New Treatment for Meat Packing Wastes. *Public Works*, 62: 25-26 and 74 (July).

A description of the treatment plant for the superchlorination of packing house wastes is given. It is reported that the sludge obtained has a high fertilizer value.

Halvorson, H. O. An Innovation in Meat Packing Waste Treatment. *Munic. Sanit.*, 2: 166-170 and 176 (April).

A description is given of the process developed for the recovery of proteins from packing house wastes by superchlorination.

Halvorson, H. O., A. R. Cade, and W. J. Pullen. Recovery of Proteins from Packing House Waste by Superchlorination. *Sewage Works J.*, 3: 488-501 (July).

The process in which superchlorination is utilized in the recovery of proteins from packing house wastes is described.

Hasselmann, Djalma. Slaughterhouse Residues. *Rev. Soc. Brasil Chim.*, 2: 386 ().

1931 (continued)

Analyses of the undigested matter from the digestive tract of slaughtered animals showed sufficient phosphorus ($P_2O_5 = 1.52\%$) to make it a potential source of fertilizers.

Koch, Hans. Working Up Animal Waste. German Patent 567,695 (March 14).

A modified process is described for treating slaughterhouse wastes with gaseous or liquid oxidizing agents and washing prior to boiling under a pressure of up to 2 atmospheres.

Makinson, George A. Collection, Treatment and Utilization of Domestic Refuse in Birmingham, England. U. S. Consular Reports, 25 pp. ().

Organic by-products are made from market and slaughterhouse wastes. The nature of these products and the reduction plant in the Iwell process is described.

Oppenheim, Rudolf S. Recovery of Protein Matter from Packing House Tank Water and Distillery Slop. U.S. 1,815,160 (July 21).

Milk is mixed with the material and then coagulated so that the coagulum carries down proteinaceous matter; the precipitate may be dried and used as chicken feed.

1930

Butzler. Treatment of the Waste Waters of Slaughter and Cattle Yards. Gesundh. Ing., 53: 391 ().

At Cologne the waste waters are treated in a mechanical clarification plant, blood is collected separately and utilized, sludge is collected, removed and composted, and is used as a fertilizer. The clarified effluent discharges to the city sewers.

Decker, J. E. Treating Meat Plant Waste. Nat. Provisioner, 82: 27-28 and 53 (January 25).

1930 (continued)

Gusev, S. P. Organic Industrial Wastes as Nitrogen Fertilizers. Udobrenie i Uroshai, 2: 614-632 ().

Studies indicated that stomach contents from slaughterhouse wastes may be used as fertilizers in pot and field experiments because of their nitrogen content. Since the keeping qualities are poor and the fertility values are low, they can not be hauled great distances and may be used only in the vicinity of the slaughterhouse.

Mossolov, V. P. Use of Industrial Wastes as Fertilizers. Udobrenie i Uroshai, 2: 182-186 ().

Field trials are cited to show the value of various kinds of slaughterhouse wastes as fertilizers.

Nichols, M. Starr and John C. Mackin. Packing-Plant Waste Treatment. Sewage Works J., 2: 435-442 (July).

Treatment of packing house wastes by plain sedimentation and trickling filters resulted in 90 per cent reduction based on removal of suspended solids, organic nitrogen, and fats and about 80 per cent based on biochemical oxygen demand reductions.

Steel, Earnest W. Present Practice in Industrial Waste Treatment. Public Works, 61: 9, 21 (September).

The methods used for treating packing house wastes are reviewed.

1929

Levine, Max, Harry N. Jenks, and F. G. Nelson. Comparison of Diffused Air and Stream-Flow Aeration in Purification of Packinghouse Wastes. Sewage Works J., 1: 425-430 ().

A more rapid reduction of organic nitrogen, oxygen consumed, and 5-day biochemical oxygen demand was obtained by the stream-flow aeration method than by diffused aeration.

1929 (continued)

Schulze, S. Articles (Bibliography) on Waste Waters from Abattoirs and Cattle Yards. *Kleine Mitt. Mitgleider Ver. Wasser-, Boden-, Lufthyg.*, 5: 285 (1929); 6: 268 and 337 (1930).

A list of 104 references on waste waters from abattoirs which appeared during the period 1904 and 1929 is given.

1928

Cohen, Chester. Disposal of Packing House Waste by Irrigation at Laredo, Texas. *Public Works*, 59: 377 ().

The disposal of combined sewage and packing house waste by sewage irrigation is described.

Mohlman, F. W. Industrial Waste Work of the Sanitary District of Chicago. *Sewage Works J.*, 1: 108 (October).

Reference is made to a paper with the above title that was presented at the Tenth Texas Water and Sewage Works School. It is noted that studies of industrial wastes in Chicago showed that activated sludge treatment was most effective for packing house wastes.

_____. (b). Industrial Waste Work of the Sanitary District of Chicago. *Water Works*, 67: 163-166 ().

The 5-day biochemical oxygen demand of domestic sewage per capita per 24 hours at 20° C. was found to be 0.167 pounds. Activated sludge treatment was found satisfactory for packing house wastes.

Moulton, C. Roberts. Chemical Engineers in the Meat Packing Industry. *Chem. & Met. Engr.*, 35: 296-298 (May).

Methods of rendering packing house wastes are described.

Porter, A. B. and J.A. Cresswick. The Causes and Prevention of Hydrogen Sulfide in Abattoir Sewage. *J. Soc. Chem. Ind.*, 47: 380-T (December 28).

1928 (continued)

Because of the discharge of abattoir wastes a serious nuisance from hydrogen sulfide resulted in a residential area. Elimination of coarse paunch manure from abattoir sewage greatly improved conditions.

Rudolfs, Willem and H. Kessener. Treatment of Slaughterhouse Waste in Holland. Public Works, 59: 151-154 (April).

A description is given of the brush aeration activated sludge plant for treating packing house wastes. Operating results are reported.

Whedbee, Edgar. The Treatment of Industrial Wastes. Sewage Works J., 1: 109 (October)

Reference is made to the papers presented at the Tenth Texas Water and Sewage Works School. It is noted that activated sludge has been used successfully in the treatment of packing house wastes.

1926

Mohlman, F. W. Treatment of Packing House, Tannery and Corn Products Wastes. Ind. Eng. Chem., 18: 1076-1081 (October).

Data are presented on the operation of packing houses in the Sanitary District of Chicago.

Moor, W. C. and W. P. Wayne. The Treatment of Packing House Sewage. Ind. Eng. Chem., 18: 239 (March).

Packing house sewage is screened and settled. The effluent is discharged to municipal sewers.

1925

Rolants, E. Waste Waters. Bailliers et Fils. Paris.

1923

Harris, John P. The Dry Rendering of Fats. Chem. & Met., 29: 93-96 (July 16).

A description is given of dry rendering as opposed to wet rendering in the handling of waste materials from the meat-packing industry.

1921

Dilling, A. W. and L. Pearse. Report on Industrial Wastes from the Stockyards and Packingtown in Chicago.

1914

Wisner, G. M. Report on Industrial Wastes from the Stockyards and Packingtown in Chicago.

Dates unknown at present

Siegy, F. Handbuch der Lebensmittelchemie. Gewerbliche und Industrielle Abwässer. Abwässer aus Schlachthäusern und verwandten Betrieben, z. B. Wurstfabriken, Konservenfabriken, pp. 489-497.

A book.

Texas State Department of Health. Sanitation in Meat Processing. 20 pp.

Some data are presented on abattoir wastes. Suggestions are offered for the sanitary construction of slaughterhouses, abattoirs, and locker storage plants.

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